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CHAPTER ONE:

INTRODUCTION

The primary purpose of this manual is to establish a uniform policy of inspection procedures and standards for the inspection of precast prestressed structural member fabrication. Also included in this manual is an example of the typical documentation required for these activities. The objective is to ensure that the fabricated precast prestressed structural member has been produced in accordance with INDOT plans and specifications.

Technicians are assigned to Precast Prestressed Fabrication Shops for the purpose of Quality Assurance (QA) inspection, and are the contacts between INDOT and the Fabricator. QA fabrication inspection requires close attention to details and procedures required by INDOT to verify that the work performed by the Fabricator is of the quality required by the contract.

The actual construction of a precast prestressed concrete structural member begins when the final approved shop drawings are sent to the shop fabrication floor and continues through fabrication until the structural members are finally put to use. The Fabricator performs Quality Control (QC) and is responsible for the completion of a structural member in accordance with the design drawings and the approved shop drawings. The Technician is responsible for the QA portion of the work. Shop practices and procedures differ with each Fabricator and with each crew within each fabrication plant. INDOT does not specify the procedures of each Fabricator; however, all procedures and workmanship are required to be in accordance with the specifications and details on the plans.

Specifications for precast prestressed concrete structural members are included in Section **707** of the Standard Specifications.

LINES OF AUTHORITY AND COMMUNICATION

The Technician has the authority, using the plans, Standard Specifications, and the contract Special Provisions to make decisions on acceptance or rejection of materials and members produced from these materials. Solutions to any discrepancies or disagreements with the Fabricator, which the Technician feels is beyond his authority to make, should immediately be referred to the District Testing Engineer (DTE).

The Technician has the responsibility to use the plans, Standard Drawings and Specifications, and the contract Special Provisions to verify that all materials are within INDOT current specifications. When there is a defect, the DTE will request a repair procedure from the Fabricator.

When necessary, the Division of Construction Management is available to review and discuss situations that cannot be resolved between the Fabricator, the Technician, and the DTE. These situations are required to be reported by the DTE.

If the Fabricator proposes changes that differ from the plans, the Technician will contact the INDOT Fabrication Supervisor and the Supervisor will contact the DTE and PE for approval of any changes.

The chart in Figure 1-1 indicates the relationship between INDOT and the parties involved in the project. A solid line represents a direct relationship or direct contract between the parties. A dashed line represents a working relationship between INDOT and that party; however, there is no direct contract between them. All formal changes are required to be made through the Prime Contractor.

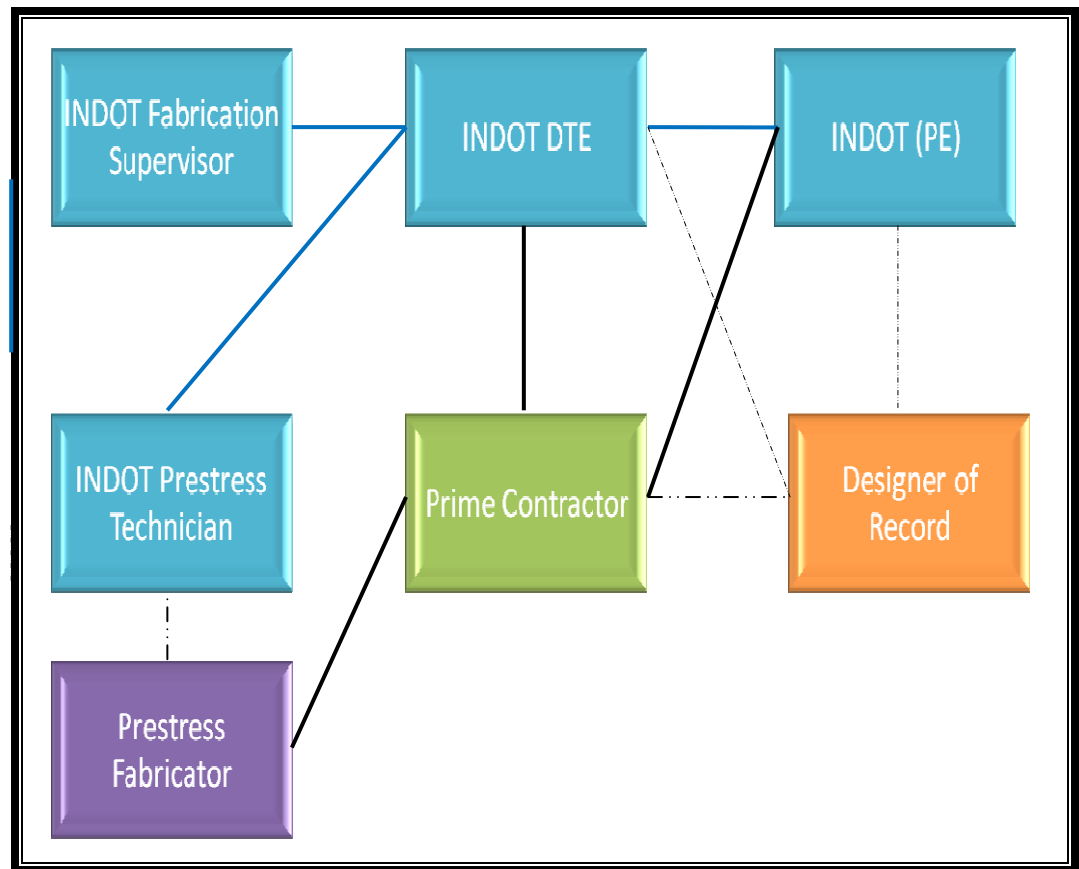


Figure 1-1. Line of Communication

Refer to Chapter 7 for more information in regards to what correspondences are needed in regards to changes in design or materials produced out of compliance with specifications.

SAFETY

Safety is of great importance to the Technician when working in the fabrication facility. At no time should the Technician be put in a potentially dangerous location or position in the fabrication facility. The Fabricator and Technician are required to work closely together to identify and correct any potentially dangerous situations. The Technician is required to follow all safety rules and regulations of the fabricating facility and INDOT including wearing all required Personal Protective Equipment (PPE). INDOT will supply the Technician with the necessary PPE. Consultant Technicians will provide their own PPE.

SAFETY MEASURES DURING PRESTRESSING

The specifications require the Fabricator to provide all safeguards, safety devices, and protection equipment necessary to protect personnel. This protection consists of a screen of heavy plywood, wire mesh, or a combination of both, or of other suitable materials, placed in front of the strand anchorage. The barrier is required to be of adequate width and height and of sufficient strength to withstand a strand that breaks or becomes suddenly released when under tension. This requirement is particularly important during tensioning of the strands. Breakage of the strands is more likely to occur during rather than after tensioning. A tensioned casting bed is considered as potentially dangerous. After a strand breaks, the cable and strand vise will project back with considerable force. The Technician is required to avoid careless or unnecessary exposure to injury such as standing directly in line with a tensioned strand, leaning over a tensioned strand, or placing their face or hands in close proximity to a tensioned strand. If in the opinion of the Technician the safety precautions are inadequate, the DTE is informed immediately.

In many Fabrication plants, the prestressing operation is done inside of a closed structure such as a bunker plate (Figure 1-2). This operation may be safely viewed from the control panel located outside the structure. The Technician is required to stand outside of the bunker when strands are being stressed.



Figure 1-2. Bunker Plate

Other prestressing beds have a steel screen (Figure 1-3) behind the hydraulic jack that is stressing the strands. Personnel are not allowed to stand between the screen and the hydraulic jack stressing the strands.



Figure 1-3. Steel Screen

SAFETY MEASURES DURING MOVEMENT OF STRUCTURAL MEMBERS

Structural members are moved in the yard for various reasons to include loading the members on trucks for transportation to the project or to rearrange the members in the yard to make room for additional storage of other members. During the movement of the members, the Technician will not be in the vicinity of the straddle cranes that are moving the member. Occasionally structural members have been in storage for an extended period of time and the lift loops may have deteriorated. Also, the wooden battens used to support the member may have rotted and no longer are capable of supporting the member. The structural member illustrated in Figure 1-4 tipped over due to the rotten wooden battens collapsing.



Figure 1-4. Bulb Tee Beam Tipped Over

EQUIPMENT

INDOT will supply the Technician with the inspection equipment to perform all of the necessary duties. Consultant Technicians will provide their own inspection equipment. If there are discrepancies with the test results obtained by the Fabricator, the Technician will provide to the Fabricator the equipment calibration records. The Technician will also obtain the calibration records of the equipment used by the Fabricator. The Technician will keep the inspection equipment in calibration at all times. Most calibrations are done on a semi-annual or annual basis by the District Testing Lab or other companies.

PLANS AND SPECIFICATIONS

A thorough knowledge of the plans and specifications is essential before the Technician begins work on each contract. Prestressed materials are exposed to much higher stress values than found in ordinary work. The higher stress values necessitate close attention to specified requirements or the prestress work will not produce the desired results. Every requirement on the plans or in the specifications is important.

The Technician is given a stamped "Approved" set of shop drawings from the DTE along with any Special Provisions for the contract. These drawings are stamped approved by Central Office Division of Structural Engineering or their designated representative. Fabrication shall not begin until the Fabricator and Technician have an approved set of shop drawings. A transmittal letter that lists each approved drawing and any revisions to the drawings is required to accompany the shop drawings.

The District Office will provide the Technician with a Contract Information Book (CIB) with all revisions, and a set of design drawings for the contract. The Technician will compare the design drawings to the shop drawings for any discrepancies. If the Technician does find any discrepancies between the design drawings and the Fabricator shop drawings, the discrepancies will immediately be reported to the DTE. The design plans hold over approved shop drawings (Section 105.04). Shop drawings are not listed in 105.04 because they are not provided by INDOT. Any Special Provisions hold over plans, Supplemental Specifications, and the Standard Specifications. Special Provisions will be found in the CIB.

The design drawings, CIB, and INDOT approved shop drawings are available electronically from the INDOT website and the Department Y drive. If drawings cannot be found, contact the DTE.

INDOT TECHNICIAN REQUIREMENTS

The INDOT Technician is required to have a thorough knowledge of the following to perform the duties at a precast prestressed concrete plant:

INDOT Standard Specifications and Contract Special Provisions
INDOT Frequency Manual
Shop Drawings
INDOT Design Drawings

The INDOT Technician is required to be a Qualified Technician for the following test methods:

AASHTO T 22 Compressive Strength
AASHTO T 23 Making and Curing Specimens
AASHTO T 119 Slump
AASHTO T 121 Unit Weight and Relative Yield
AASHTO T 152 Air Test
AASHTO T 255 Moisture Content of Aggregates
AASHTO R 60 Sampling Fresh Concrete
*ASTM C 173 Volumetric Air Test
ITM 207 Sampling Aggregates
ITM 403 Water/Cementitious Ratio
*only if lightweight or slag aggregate is used

TERMINOLOGY

AASHTO – American Association of State Highway and Transportation Officials

Absorption - The amount of water absorbed under specific conditions, usually expressed as a percentage of the dry weight of the material; the process by which the water is absorbed.

Accelerator - An admixture which, when added to concrete, mortar, or grout, increases the rate of hydration of hydraulic cement, shortens the time of set, or increases the rate of hardening or strength development.

ACI - American Concrete Institute

Admixture - A material other than water, aggregates, and portland cement (including air-entraining portland cement, and portland blast furnace slag cement) that is used as an ingredient of concrete and is added to the batch before and during the mixing operation

Agitating Truck - A vehicle in which freshly mixed concrete can be conveyed from the point of mixing to that of placing; while being agitated, the truck body may either be stationary and contain an agitator or may be a drum rotated continuously so as to agitate the contents

Air Content - The amount of air in mortar or concrete, exclusive of pore space in the aggregate particles, usually expressed as a percentage of total volume of mortar or concrete

Air-Entraining Admixture - An addition for concrete which causes air, usually in small quantity, to be incorporated in the form of minute bubbles in the concrete during mixing, usually to increase its workability and frost resistance. An entrapped air void is characteristically 1 mm or more in width and irregular in shape whereas an entrained air void is typically between 10 and 1000 μm in diameter and spherical or nearly so

Air-Entrainment - The inclusion of air in the form of minute bubbles during the mixing of concrete or mortar

Alkali-Silica Reaction - The reaction between the alkalies (sodium and potassium) in portland cement binder and certain siliceous rocks or minerals, such as opaline chert, strained quartz, and acisic volcanic glass, present in some aggregates; the products of the reaction may cause abnormal expansion and cracking of concrete in service

Approved Concrete Plant – A concrete plant that meets the requirements of ITM 405

ASTM – American Society for Testing and Materials

Bulk Specific Gravity - The ratio of the weight in air of a given volume of a permeable material (including both permeable and impermeable voids normal to the material) at a stated temperature to the weight in air of an equal volume of distilled water at the same temperature

Bulk Specific Gravity (Saturated Surface Dry (SSD)) – The ratio of the weight of a volume of a material including the weight of water within the pores in the material (but excluding the voids between particles) at a stated temperature, to the weight of an equal volume of distilled water at a stated temperature

Camber – a slight convexity, arching, or curvature of a beam or girder for the purpose of compensating for the deflection when loads are applied

Cement, Blended - A hydraulic cement consisting essentially of an intimate and uniform blend of granulated blast-furnace slag and hydrated lime; or an intimate and uniform blend of portland cement and granulated blast-furnace slag cement and pozzolan, produced by intergrinding Portland cement clinker with the other materials or by blending Portland cement with the other materials, or a combination of intergrinding and blending

Cement, High Early-Strength - Cement characterized by producing earlier strength in mortar or concrete than regular cement, referred to in as Type III.

Cementitious Materials - Substances that have hydraulic cementing properties (set and harden in the presence of water); includes ground, granulated blast-furnace slag, natural cement, hydraulic hydrated lime, and combinations of these and other materials

Central Office – INDOT Office located at 100 N Senate Ave in the Indiana Government Center North Building in Indianapolis, Indiana

Certified Aggregate Producer – A Plant/redistribution Terminal that meets the requirements of ITM 211, continues to be under the same ownership, and is approved by INDOT

Certified Precast Prestressed Concrete Producer - Producer that meets the requirements of ITM 814

CIB – Contract Information Book

Coarse Aggregate - Aggregate that has a minimum of 20 percent retained on the No. 4 (4.75 mm) sieve

Compressive Strength - The measured resistance of a concrete or mortar specimen to axial loading; expressed as pounds per square inch (psi) of cross-sectional area

Contractor – The individual, partnership, firm, corporation, or combination of same contracting with or desiring to contract with the Department for performance of prescribed work

Curing - The maintenance of a satisfactory moisture content and temperature in concrete during its early stages so that desired properties may develop

Designer of Record – The person who designed and stamped the contract plans

Department (Indiana Department of Transportation (INDOT)) - The agency as constituted under the laws of Indiana for the administration of highway work

DTE – District Testing Engineer

District Office – INDOT Office located within one of the six Districts

Engineer – The Chief Engineer of the Department acting directly or through the duly authorized representatives

Entrained Air - Round, uniformly distributed, microscopic, non-coalescing air bubbles entrained by the use of air-entraining agents; usually less than 1 mm (.04 in.) in size

Entrapped Air - air in concrete that is not purposely entrained. Entrapped air is generally considered to be large voids (larger than .04 in.)

Fabrication Supervisor – INDOT District Testing employee that monitors all testing and quality operations during the production of precast prestressed structural members. This position may also serve as the Technician.

Fabricator – Individual or firm that has subcontracted with the Prime Contractor to produce structural members for the contract

Fine Aggregate - Aggregate that is 100 percent passing the 3/8 in. (9.5 mm) sieve and a minimum of 80 percent passing the No. 4 (4.75 mm) sieve

Fly Ash - The finely divided residue resulting from the combustion of ground or powdered coal and which is transported from the fire box through the boiler by flu gasses; used as mineral admixture in concrete mixtures

Frequency Manual – A document issued by the Department which is titled Manual for Frequency of Sampling and Testing and Basis for Use of Materials. The number of samples and tests, the basis for approval, the basis for use, and similar requirements for furnished materials are specified in the document.

Hardening - When portland cement is mixed with enough water to form a paste, the compounds of the cement react with water to form cementitious products that adhere to each other and to the intermixed sand and stone particles and become very hard. As long as moisture is present, the reaction may continue for years, adding continually to the strength of the mixture.

Heat of Hydration - Heat evolved by chemical reactions of a substance with water, such as that evolved during the setting and hardening of portland cement

High Early-Strength Concrete - Concrete that, through the use of high-early-strength cement or admixtures, is capable of attaining specified strength at an earlier age than normal concrete

Honeycomb - Concrete that, due to lack of the proper amount of fines or vibration, contains abundant interconnected large voids or cavities; concrete that contains honeycombs was improperly consolidated.

Hydration - The chemical reaction between cement and water which causes concrete to harden

Independent Assurance Technician (IAT) – The District Testing Engineer representative responsible for monitoring the Acceptance Technician to make checks on the reliability of the results obtained in acceptance sampling, sample reduction, and testing. The Independent Assurance Technician will not conduct any contract acceptance testing.

Indiana Test Method (ITM) – Written documentation of various test procedures, general testing instructions, programs, and protocols which are used by the Department and not covered by ASTM, AASHTO, or other national Standard Specifications

Maximum Particle Size - The sieve on which 100 percent of the material will pass

Nominal Maximum Particle Size - The smallest sieve opening through which the entire amount of the aggregate is permitted to pass

Office of Materials Management (OMM) – INDOT Office located at 120 S. Shortridge Road in Indianapolis, Indiana

PCC - Portland Cement Concrete

Personal Protective Equipment (PPE) - Items such as ear plugs, gloves, safety glasses, hard hat, vest, etc intended to provide protection to the user

Portland Cement - A commercial product which when mixed with water alone or in combination with sand, stone, or similar materials, has the property of combining with water, slowly, to form a hard solid mass. Physically, portland cement is a finely pulverized clinker produced by burning mixtures containing lime, iron, alumina, and silica at high temperature and in definite proportions, and then intergrinding gypsum to give the properties desired.

Pozzolan - A siliceous or siliceous and aluminous material, which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties

psi – pound per square inch (lb/in²)

Quality Assurance (QA) – Planned and systematic actions by an owner or his representative to provide confidence that a product or facility meet applicable standards of good practice. This involves continued evaluation of design, plan and specification development, contract advertisement and award, construction and maintenance, and the interaction of these activities.

Quality Control (QC) – Actions taken by a Producer or Contractor to provide control over what is being done and what is being provided so that the applicable standards of good practice for the work are followed.

Quality Control Plan (QCP) - A document written by the Contractor that is product-specific and includes the policies and procedures used by the Contractor

Qualified Technician – An individual that has successfully completed the written and proficiency requirements of the Indiana Department of Transportation Qualified Laboratory and Technician Program

Retardation - Reduction in the rate of hardening or strength development of fresh concrete, mortar, or grout; i.e., an increase in the time required to reach initial and final set

Saturated Surface-Dry - Condition of an aggregate particle or other porous solid when the permeable voids are filled with water but there is no water on the exposed surface

Scaling - Flaking or peeling away of the near-surface portion of hydraulic cement concrete or mortar

Shrinkage Crack - Crack from restraint of volume reduction due to shrinkage or temperature contraction; usually occurring within the first few days after placement.

Slump - A measure of consistency of freshly mixed concrete, equal to the subsidence measured to the nearest 1/4-in. of the molded specimen immediately after removal of the slump cone

Specific Gravity - The ratio of the weight in air of a given volume of material at a stated temperature to the weight in air of an equal volume of distilled water at the same temperature

Technician – The authorized representative of the Engineer responsible for Quality Assurance. This person is responsible for observing and documenting the operations of the Fabricator and may be either a Department employee or a Consultant.

Water / Cementitious Materials Ratio – The ratio of the amount of water, exclusive only of that absorbed by the aggregates, to the amount of portland cement and the other cementitious material (fly ash, pozzolan, etc.) in a concrete or mortar mixture; preferably stated as a decimal by weight

Water-Reducing Admixture - A material that either increases slump of freshly mixed mortar or concrete without increasing water content or maintains a workability with a reduced amount of water, the effect being due to factors other than air entrainment; also know as water reducer

Water-Reducing Admixture (High Range) - A water-reducing admixture capable of producing large water or great flowability without causing undue set retardation or entrainment of air in mortar or concrete

Workability - The property of freshly mixed concrete or mortar which determines the ease and homogeneity with which concrete may be mixed, placed, compacted, and finished

Yield - The volume of fresh concrete produced from a known quantity of ingredients; the total weight of ingredients divided by the unit weight of the freshly mixed concrete